GO solar CALIFORNIA

CSI RD&D PROGRAM

Advanced Grid-Interactive Distributed Photovoltaic & Storage

Innovative Business Model

Grantee:
SolarCity

Partners:
Tesla Motors, University of California Berkeley Renewable & Appropriate Energy Laboratory, University of California Berkeley Energy & Resources Group & Mechanical Engineering, Pacific Gas & Electric

CSI RD&D Funding:
$1,550,867

Match Funding:
$564,743

Project Timeframe:
2011-2013

RD&D Project Portal:
calsolarresearch.ca.gov/csi/76

OVERVIEW AND OBJECTIVES

The output variability of solar energy can pose operational challenges for the electricity grid; however, photovoltaics (PV) coupled with energy storage can reduce this variability. The ability to firm intermittent renewable resources will likely result in peak demand reductions and system-wide grid network benefits. To address this, SolarCity demonstrated an integrated PV and energy storage technology to enable cost-effective load shifting, demand reduction, and reduced needs for conventional ancillary services. The goals of the project were to show how these systems can reduce cost and carbon emissions and improve grid reliability and security and to identify market mechanisms necessary to bring combined PV and storage to new markets.

This project built upon an operational FirmPV installation in San Francisco, which is a combination of Tesla Motors' vehicle battery system with SolarCity's SolarGuard dispatch and monitoring platform. The SolarCity team conducted demonstrations at nine sites to assess system performance along with economic, reliability, and carbon reduction impacts of large-scale deployment of a FirmPV product. Additional tasks included conducting analysis to determine an optimal tariff product or rate plan that can provide the benefits of FirmPV at the lowest overall cost. Lastly, the SolarCity team explored a range of financing mechanisms to best enable FirmPV deployment.

This document provides a brief project description. For more detail on the project and the California Solar Initiative's (CSI) Research Development, Demonstration & Deployment (RD&D) Program, please visit calsolarresearch.ca.gov

The CSI RD&D Program is managed by Itron on behalf of the California Public Utilities Commission (CPUC).

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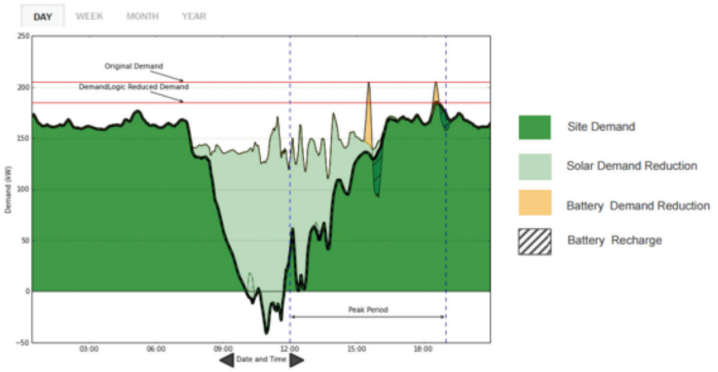
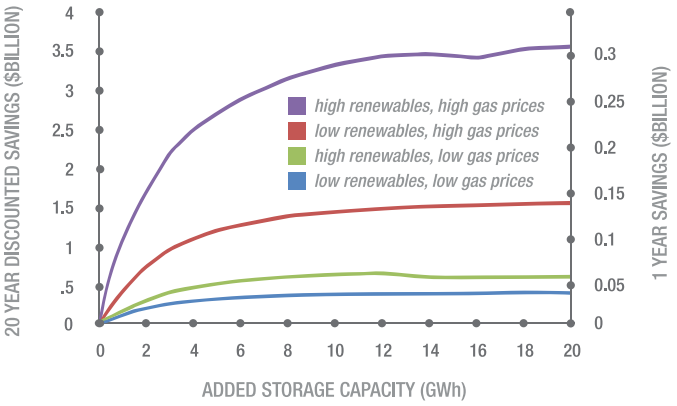
METHODOLOGY

The SolarCity team explored existing technology, both in terms of energy storage systems and communications hardware. This initial research and prototyping phase was especially crucial to the development of the Tesla lithium-ion battery product and to the selection of accompanying communications, controls, and equipment. The team completed the process of locating, designing, permitting, building, and interconnecting nine grid-interactive FirmPV systems. Once the technology was deployed, use cases were developed identifying the regulatory environment needed for the benefits of storage to be accessible. New technologies, like PV paired with grid-interactive storage, have the potential to provide substantial cost savings for utilities, ratepayers, and customers and reduce carbon emissions to a far greater degree than either PV or storage could achieve on its own, while also helping ease the strain on an aging utility infrastructure. Perceived customer benefits were analyzed along with storage financing methods, PV variability, retail and distribution benefits, and control methods to monetize FirmPV value.



User Interface for Assessing Benefits of PV and Energy Storage at a Site



System Cost Savings vs. Added Storage Capacity

RESULTS AND OUTCOMES

This research project resulted in the creation of energy storage technology that can be easily integrated with PV installations. Tesla was able to implement the design feedback in the initial pilot research and to develop both commercial and residential pilot products. Key lessons were learned in regard to equipment design, system communications and control, ease of installation, compliance with building code, and regulatory barriers. The battery technology was deployed successfully in a series of pilot installations on both commercial and residential sites. Despite some initial barriers to the interconnection process, all sites are fully operational. Valuable insights included installation constraints, the importance of education for permitting authorities, and customer feedback. The knowledge gained during the course of this project, along with the inclusion of storage projects in the CPUC's Self Generation Incentive Program (SGIP) have enabled SolarCity and Tesla to bring both commercial and residential energy storage products to market. Over a hundred of these systems have already been installed across California and both companies are continuing to explore the value that energy storage can provide.

PUBLIC BENEFITS

- Substantial cost savings and carbon emissions reduction for utilities and end customers to a far greater degree than either PV or storage could achieve on their own.
- Shared interconnection, communications, power conversion, and labor.
- Innovative finance mechanisms that have enabled recent growth in deployments of distributed energy storage systems for residential and commercial use.
- Cost effective load shifting, demand reduction, transmission and distribution asset deferral, and reduced needs for conventional ancillary services (voltage regulation, PV ramprate limiting).
- Faster deployment —through simplified site qualification and design.

As grid penetrations of PV increase it is important to understand ways to firm and increase the quality of the energy that PV delivers to the grid. Advanced energy storage paired with new or existing PV generation is likely to be one of the primary tools to achieve this goal.